Functional Description

5

Section 5

explains the machine principle and describes its function in normal conditions.

Furthermore it describes the structure and function of individual assemblies.

Section 5

Table of Contents

1 Information Flow (ADC Solo) 1

2 Functional Principle 2

2.1 Image Plate and Cassette 2

3 Digitizer 3

3.1 Components 4
3.1.1 Cassette Unit 4
3.1.2 Transport Unit 5
3.1.3 Scan Unit 6
3.1.4 Erasure Unit 7
3.1.5 VME – Rack 8
3.1.6 Boards in the VME-Rack 9
3.1.6.1 Gemini Board / BER Board 9
3.1.6.2 VME-Adapter Board 10
3.1.6.3 SAB Board (Scan Acquisition Board) 11
3.1.6.4 SCB-Board (Scan Control Board) 12
3.1.7 Power Unit 13
3.1.7.1 Power Integration Board 14

3.2 Machine Cycle 15
3.2.1 Cassette Input 15
3.2.2 Opening the Cassette and Sucking the IP 16
3.2.3 Taking the IP out of the Cassette and down to the Scan Unit 16
3.2.4 Format dependent Positioning of the IP relative to the Scan Unit 17
3.2.5 Stimulate and Scan the IP (Optical Path) 18
3.2.6 Stimulate and Scan the IP (Trigger Signals) 18
3.2.7 Collecting the Light 19
3.2.8 Unloading the IP from the Scan Unit / Image Erasion 19
3.2.9 Positioning the Cassette Unit relativ to the IP 20
3.2.10 Cassette Output 20

4 Signal- and Data Flow 21

4.1 Signal Flow 21

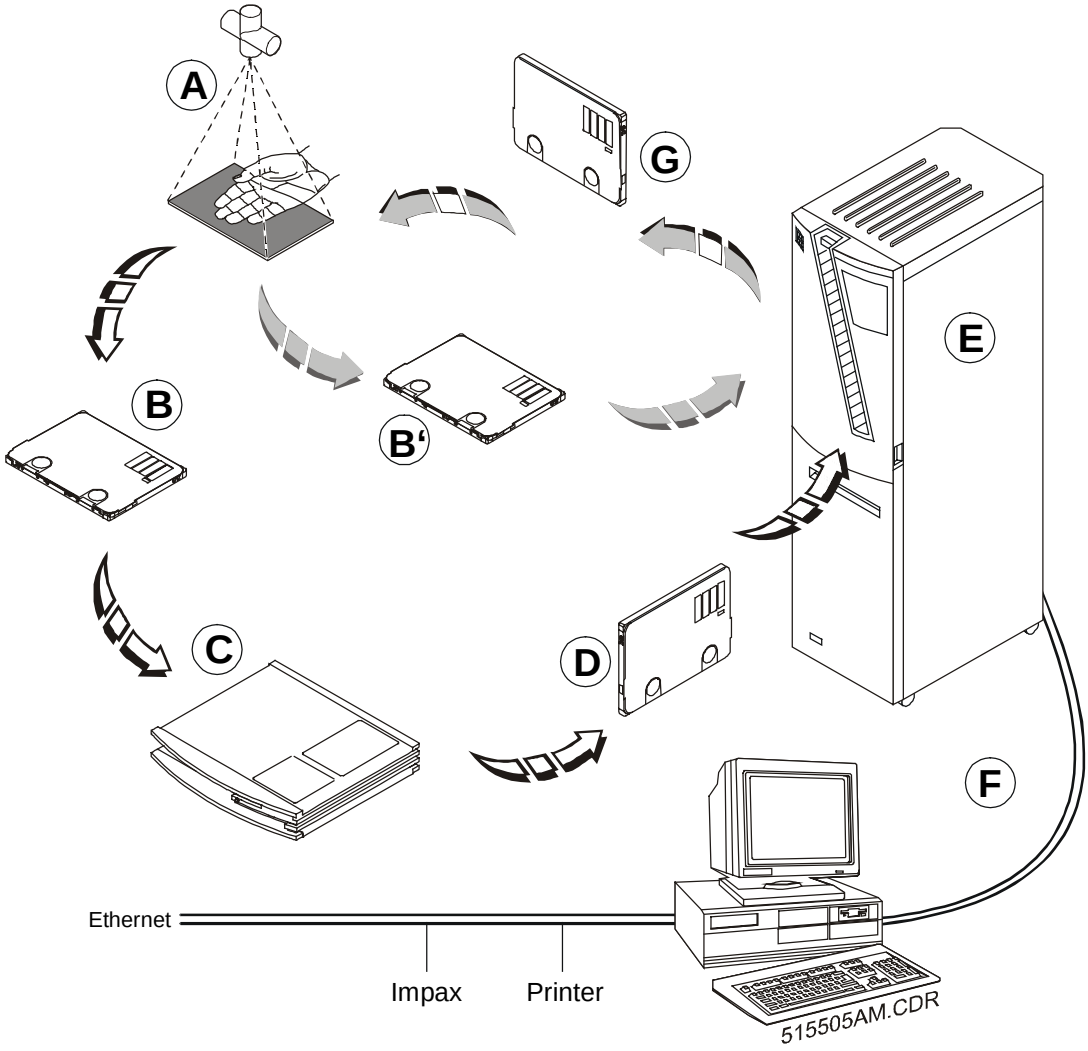
4.2 Image and Control Data Flow 22

4.3 Partition Map of the Harddisk 23

4.4 FLDXXXXX-directories: 24

4.5 NVE-List 25

1 Information Flow (ADC Solo)



Emergency Mode **“Normal” Mode**

A X-Ray tube:
Exposure of a diagnostic image on the image plate.

B Unidentified cassette with exposed image plate.

B’ Unidentified cassette with exposed image plate – emergency mode.

C ID-Station:
Input of demographic information (patient data, etc.) into the ID-chip of an exposed cassette via the RF-tag.

D Identified cassette with exposed image plate.

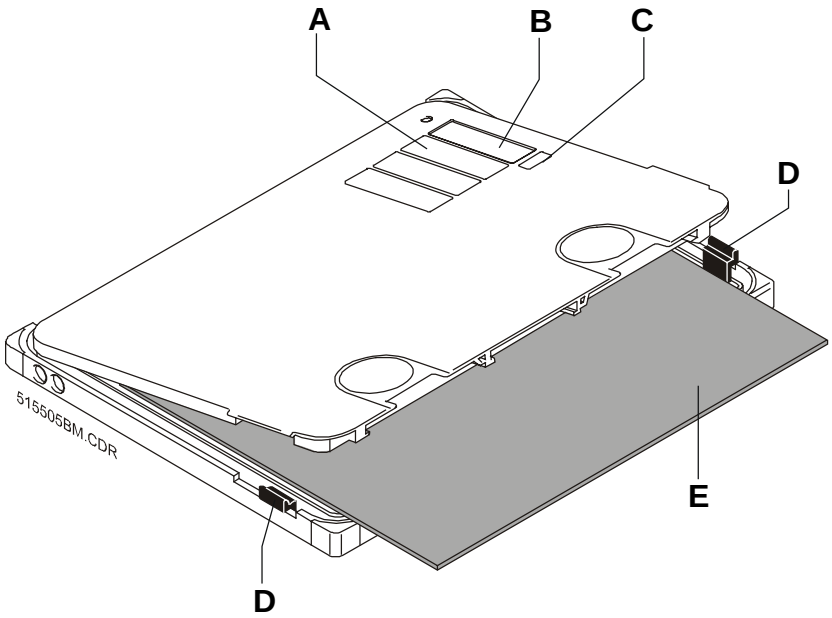
E ADC Solo digitizer:
Conversion of the diagnostic image on the image plate and of the demographic information on the ID-chip into a raw digital image with demographic data.

F Further processing of the raw image on a Processing Station via a network with DICOM-protocol.

G Processed image plates are erased in the digitizer.
The ID-chip is erased by changing the cassette status from „Identified“ to „Erased“.
The erased cassette is given back to the I / O slot of the digitizer.

2 Functional Principle

2.1 Image Plate and Cassette

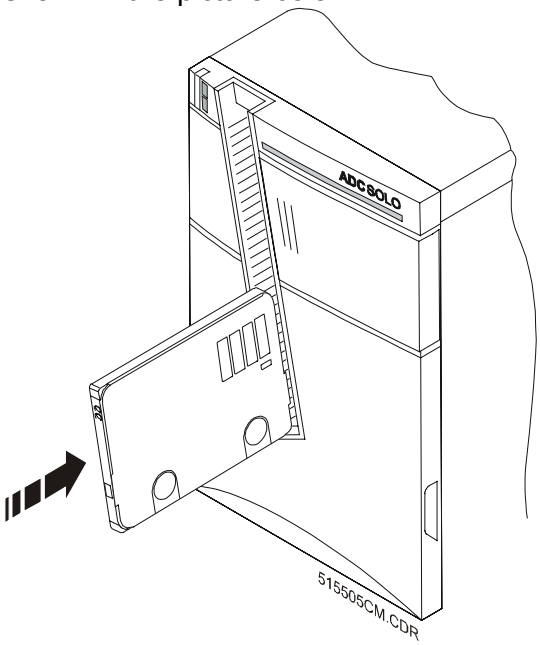


ADC cassettes are provided with:

- **A** ADC label
- **B** ID – Chip
- **C** size of Image Plate
- **D** sliders (left and right hand side) used by the digitizer to recognize ADC-cassettes
- **E** ADC – Image Plate (grey surface up, white surface down)

Image Plate (IP)	carrier of the diagnostic image
ID – Chip	carrier of the demographic data

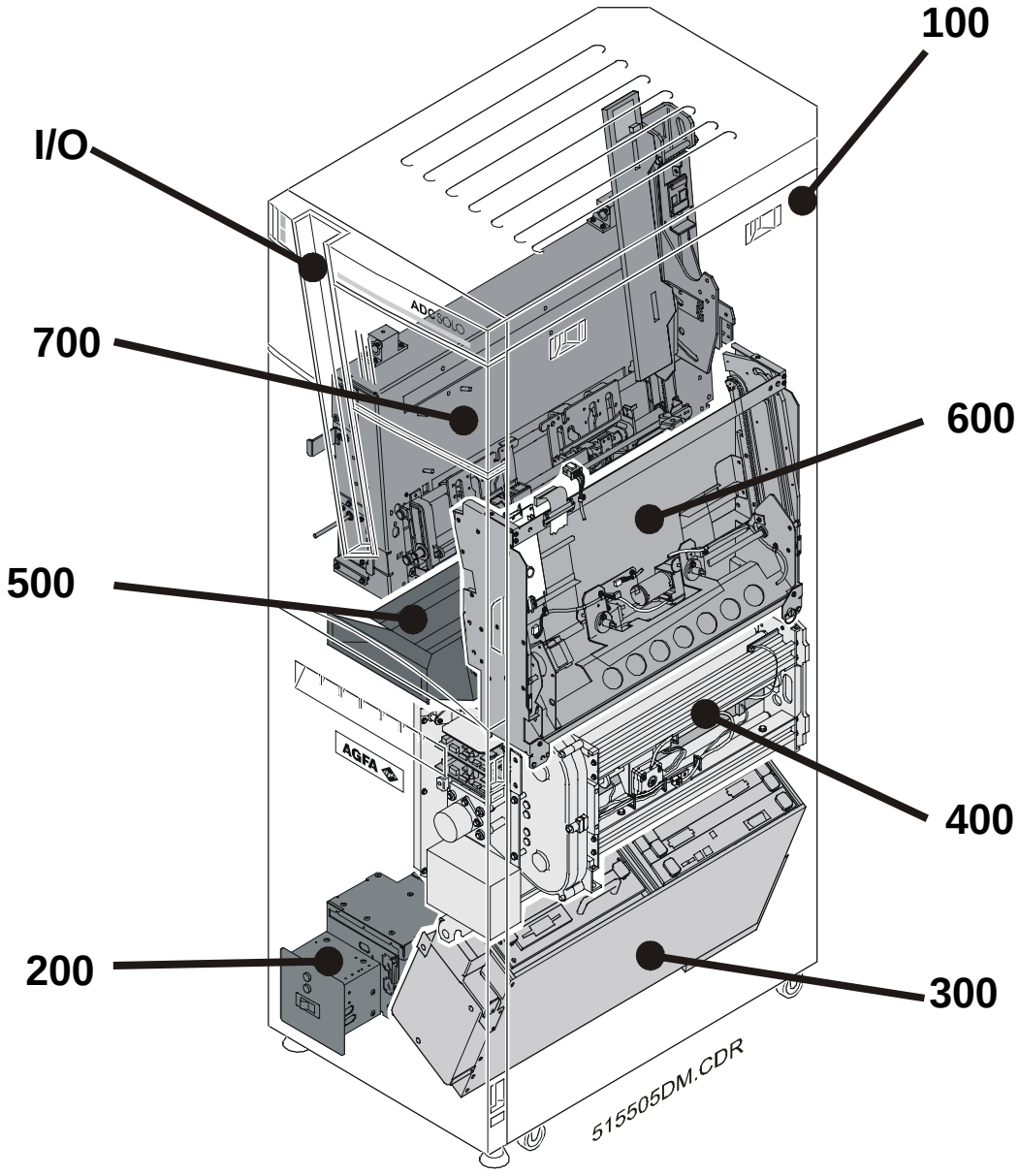
Other cassettes , e.g. mamoray, are refused by the digitizer!
Always insert cassettes as shown in the picture below.



3 Digitizer

The digitizer can be considered as a scanner for stimulable phosphor plates.
Input: Cassettes and Image Plates (IP) are handled, scanned and erased.
Output: Raw digital images sent to a processing device via network (DICOM protocol).

For normal operation no interaction is needed with the operator. Just place an exposed and identified cassette in the I / O slot.



I/O	I / O slot	100	frame
700	cassette unit	600	IP transport
500	erasure unit	400	scan unit
200	power unit	300	VME rack

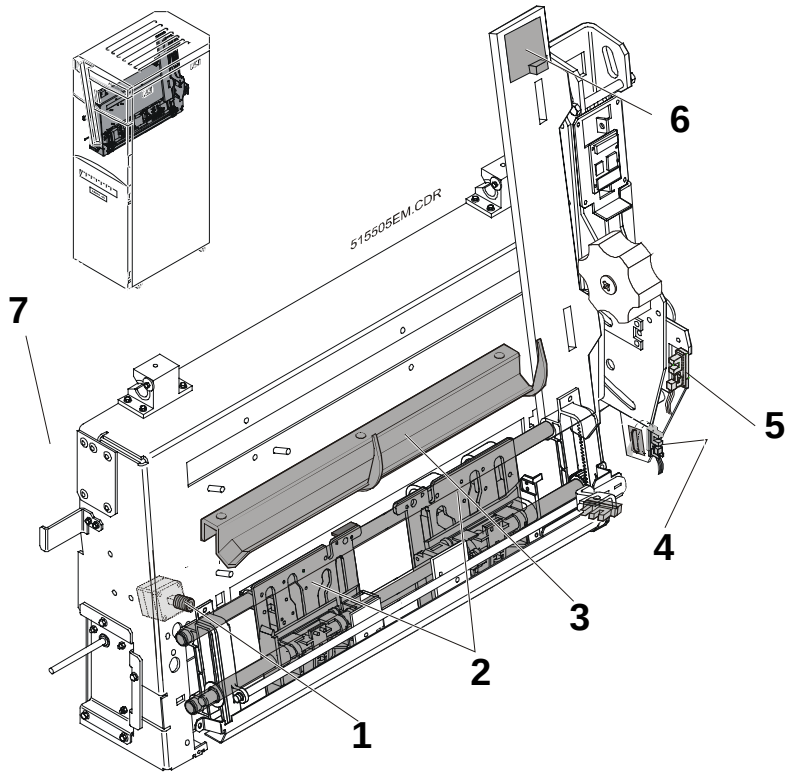
3.1 Components

3.1.1 Cassette Unit

a) Main Functions

- loading the cassette from the I/0 slot.
- reading the ID-data in the ID-chip.
- opening the cassette and unloading the image plate.
- erasing the ID-data after processing the IP by changing the cassette status from „Identified“ to „Erased“.
- transport of the cassette back to the I / O slot.
- locking and unlocking the shutter of the I/O slot.

b) Components



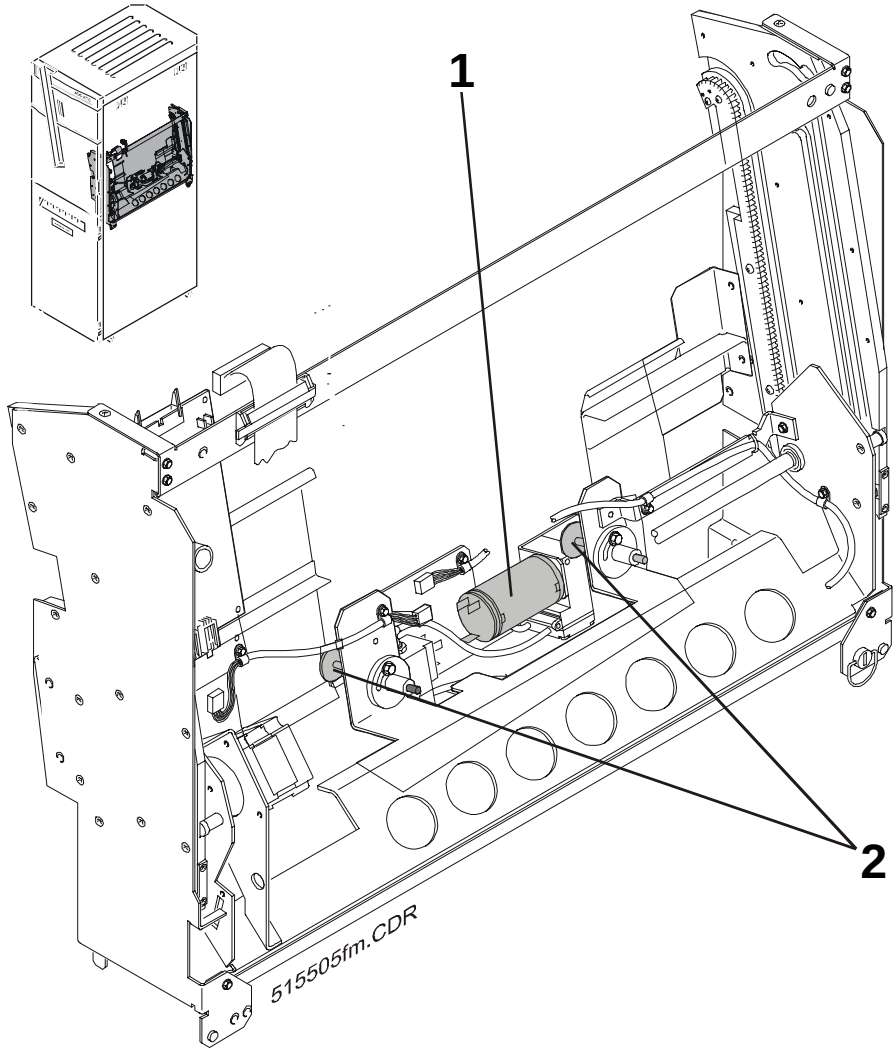
1	cassette roller
2	clamp unit
3	cassette lift
4	cassette- and position detection (LS 726)
5	cassette open lightbarrier (LS 716)
6	RF – tag reader
7	finger to block the I/O Slot

3.1.2 Transport Unit

a) Main Functions

- the transport unit takes the IP out of the cassette.
- the IP is transported to the scan unit.
- while moving upwards the IP is erased.
- the transport unit puts the IP back to the cassette.

b) Components



1 vacuum pump

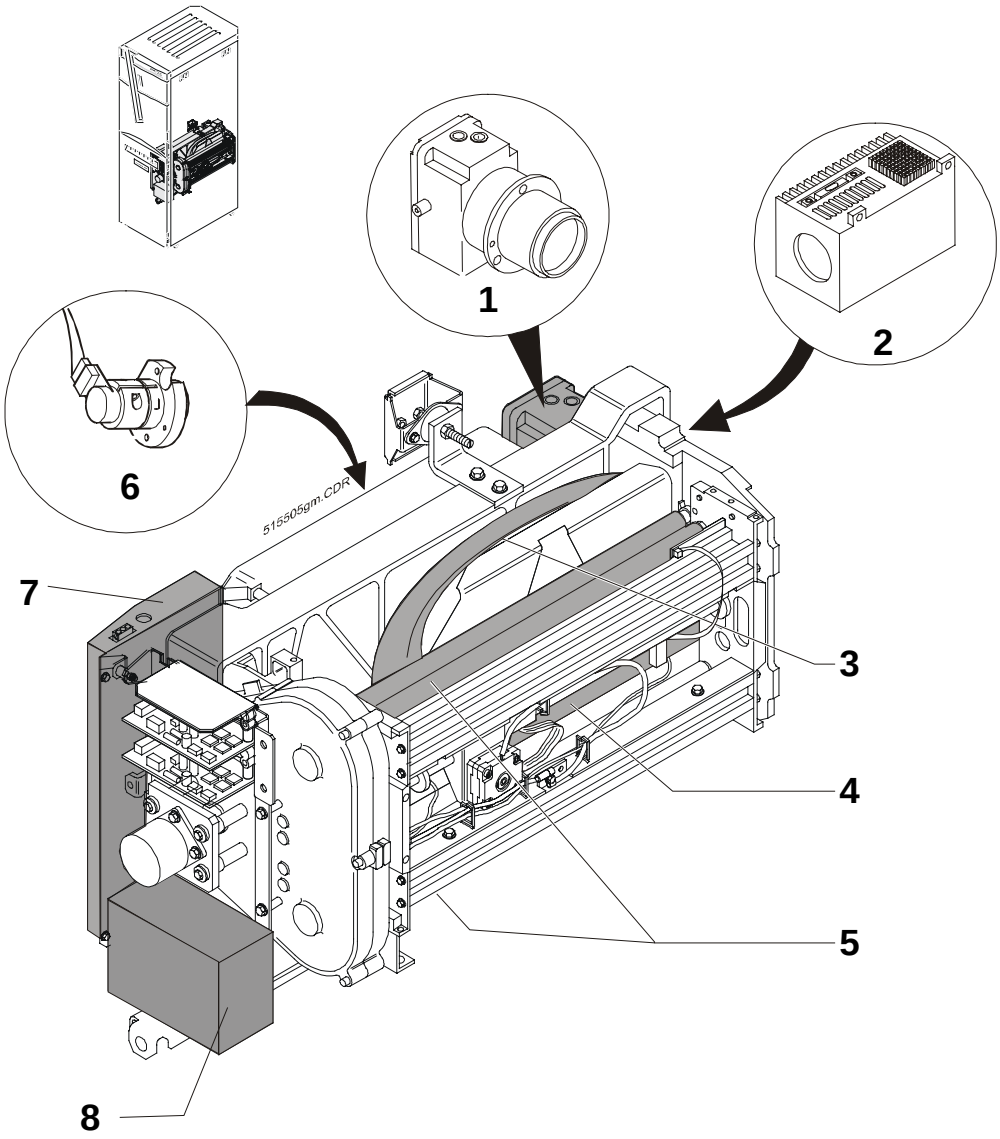
2 suction cups

3.1.3 Scan Unit

a) Main Functions

- stimulates the phosphor plate with the help of a laser diode.
- guarantees a steady transport of the IP => slowscan.
- fibre optics lead the emitted light to the photomultiplier tube (PMT).
- PMT takes exclusively the blue light =>blue light filter.
- the PMT contains the I/V converter.
- the galvo is an oscillating mirror guiding the laser beam over the IP. It is controlled by a sweep signal generated by SCB.

b) Components



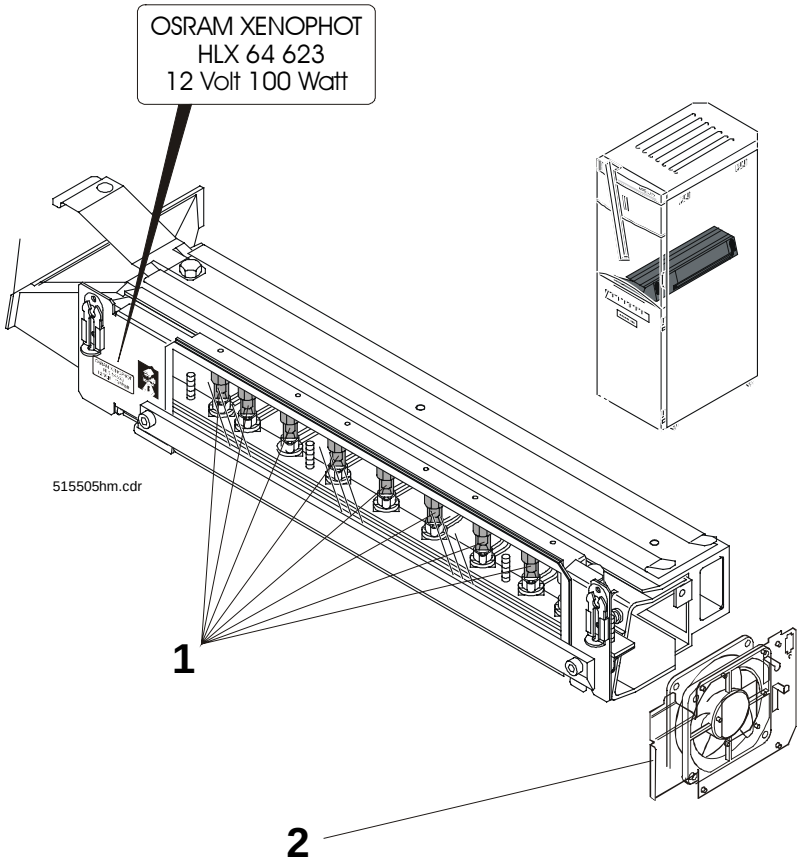
1	photo multiplier	**5**	scanner rollers (4 pcs)
2	laser diode module	**6**	galvo
3	fibre optics (2 x 6500pcs)	**7**	galvo driver board
4	PIN-diodes board	**8**	photomultiplier-HT-supply

3.1.4 Erasure Unit

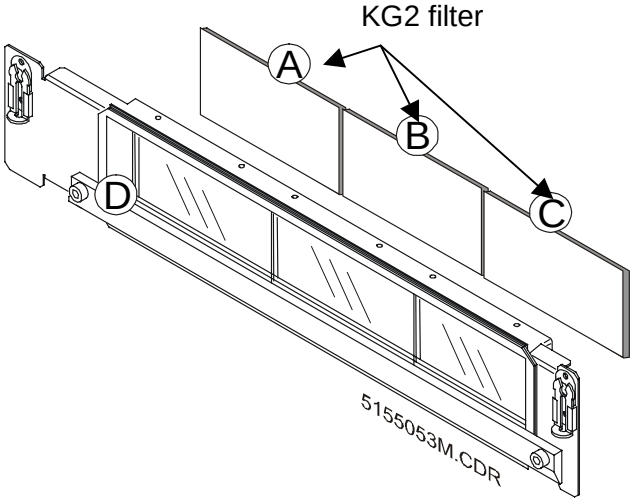
a) Main Functions

- erasing the IP. The erasure energy is determined by means of the ID – data. The erasure unit is cooled by a fan.

b) Components



1 halogen lamps (Osram Xenophot HLX 64623 12V, 100 Watt; commercially available)
2 fan



A, B, C KG2-filter (heat protection).

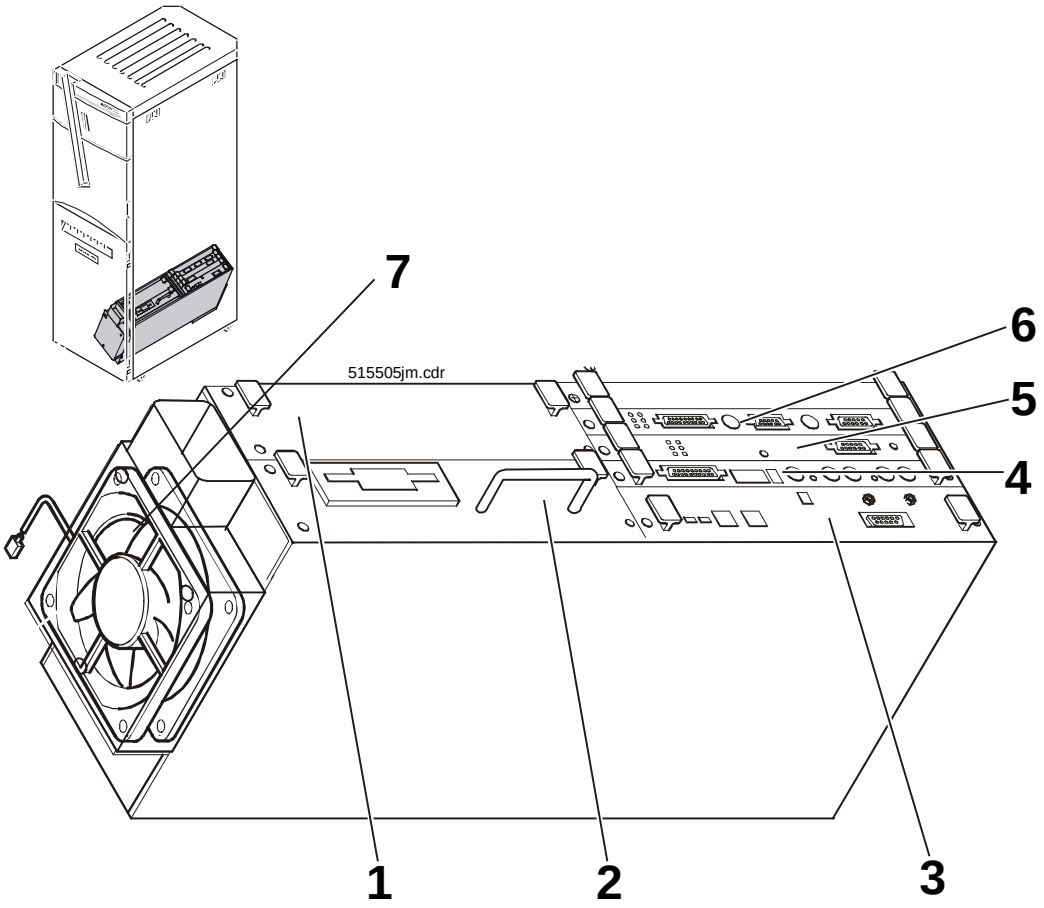
D front glass (UV-filter with sensitive gelatine layer).

3.1.5 VME – Rack

a) Main Functions

The VME-Rack contains:
- the boards.
- the fan.
- the power supply.

b) Components



1	GS320 Power Supply VME
2	GS310 Storage complete
3	GS330 CPU Gemini with BER and Memory Board
4	GS340 SCB Board (**S**can **C**ontrol **B**oard)
5	GS350 SAB Board (**S**can **A**cquisition **B**oard)
6	GS360 Adapter Board
7	Fan

3.1.6 Boards in the VME-Rack

3.1.6.1 Gemini Board / BER Board

a) Main Functions

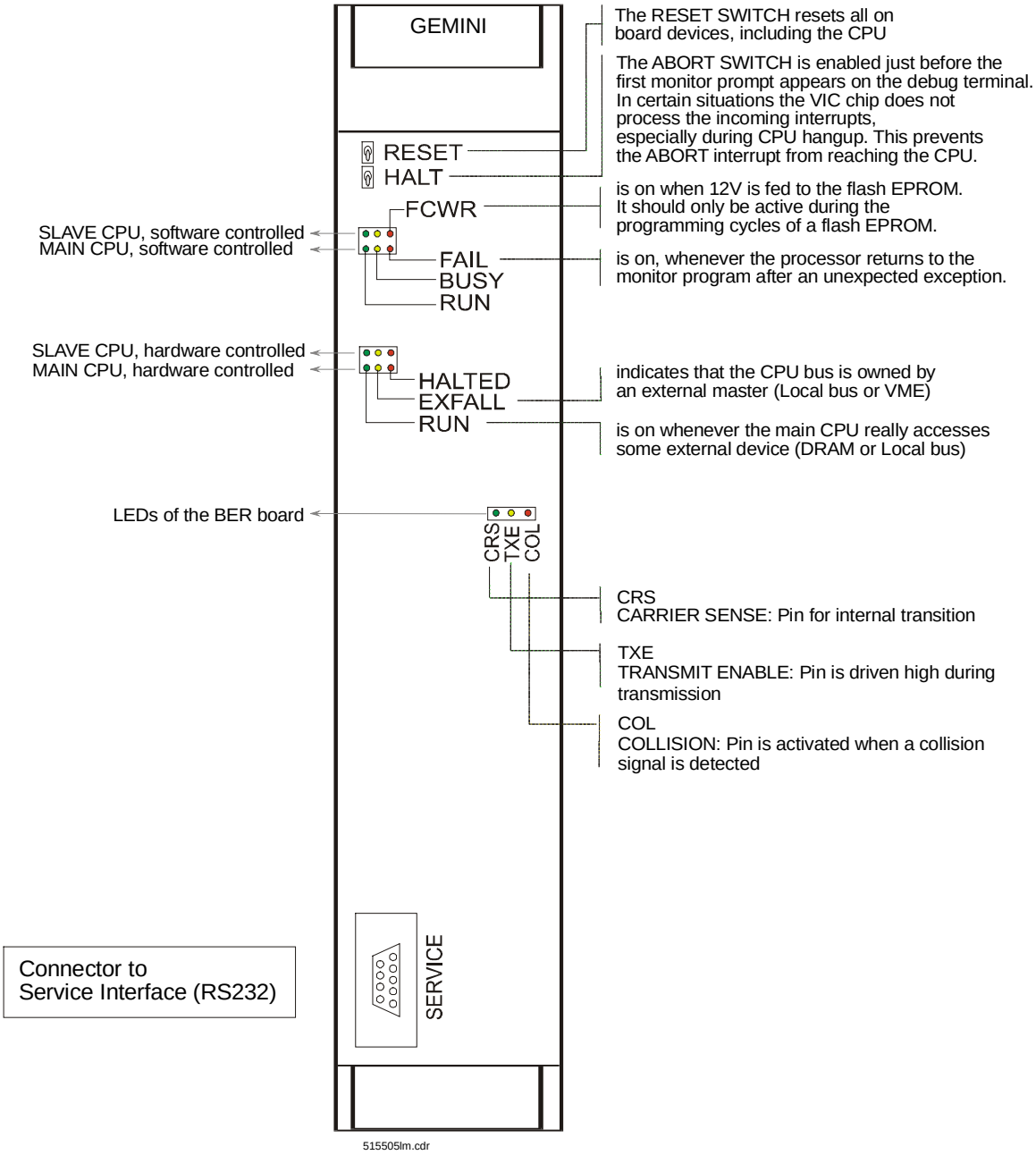
Gemini Board

- controls all the functions of the machine by dedicated driver boards.
- controls the scan process via Scan-Control-Board and Scan-Acquisition-Board.

BER-Board (**B**asic **E**thernet and **R**OCAN Interface)

- controls the internal hard disk.
- controls the floppy drive.
- drives the external Ethernet.
- drives the external serial port.

b) Front Panel Gemini / BER board

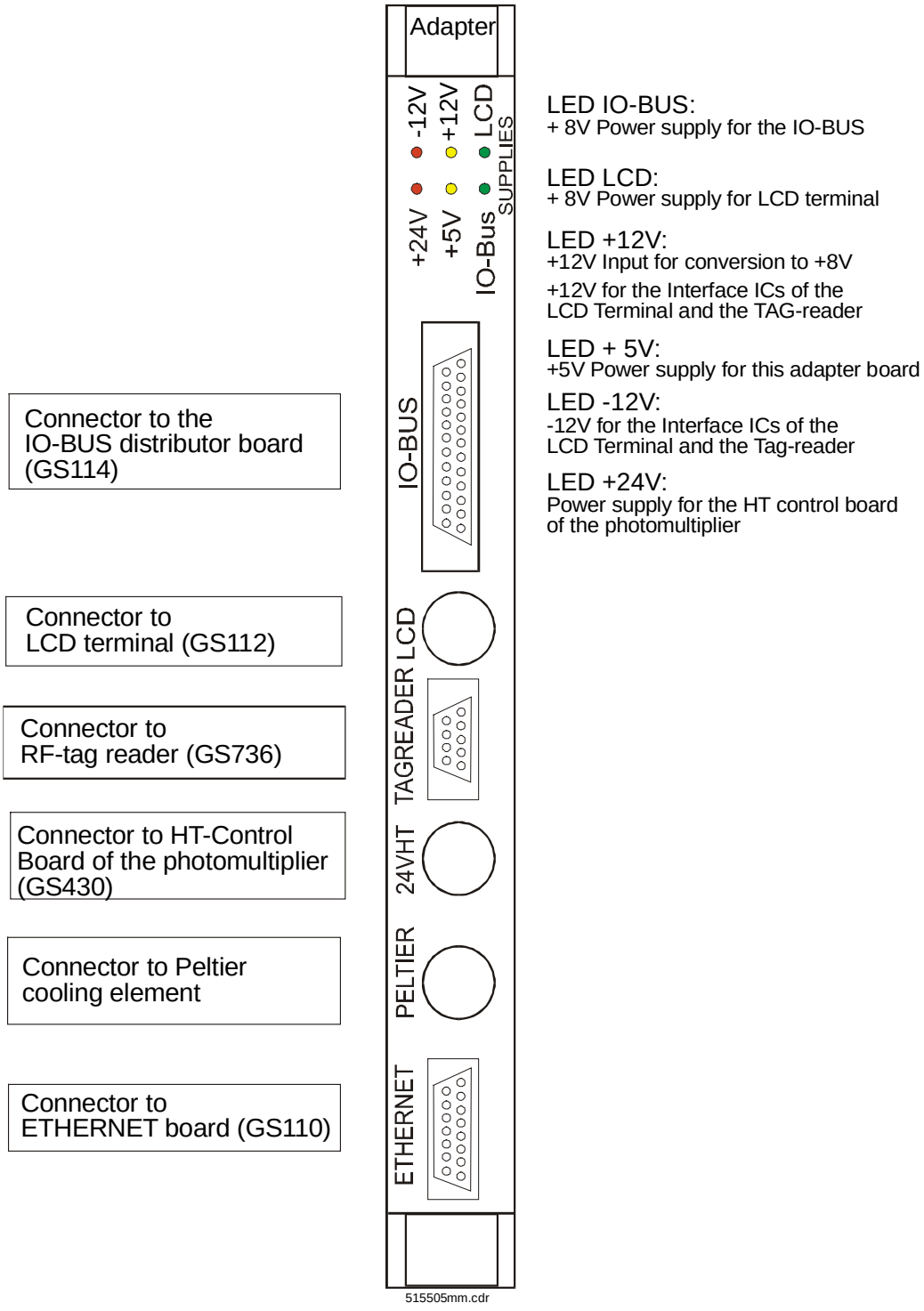

GEMINI
RESET
HALT
FCWR
SLAVE CPU, software controlled
MAIN CPU, software controlled
FAIL
BUSY
RUN
SLAVE CPU, hardware controlled
MAIN CPU, hardware controlled
HALTED
EXFALL
RUN
LEDs of the BER board
CRS
TXE
COL
SERVICE
Connector to
Service Interface (RS232)
The RESET SWITCH resets all on board devices, including the CPU
The ABORT SWITCH is enabled just before the first monitor prompt appears on the debug terminal. In certain situations the VIC chip does not process the incoming interrupts, especially during CPU hangup. This prevents the ABORT interrupt from reaching the CPU.
is on when 12V is fed to the flash EPROM. It should only be active during the programming cycles of a flash EPROM.
is on, whenever the processor returns to the monitor program after an unexpected exception.
indicates that the CPU bus is owned by an external master (Local bus or VME)
is on whenever the main CPU really accesses some external device (DRAM or Local bus)
CRS
CARRIER SENSE: Pin for internal transition
TXE
TRANSMIT ENABLE: Pin is driven high during transmission
COL
COLLISION: Pin is activated when a collision signal is detected
515505lm.cdr

3.1.6.2 VME-Adapter Board

a) Main Functions

- adaptation to Ethernet.
- voltage supply (+24V) for the photomultiplier-HT-Box (**Hi**gh **T**ension).
- connection to the R/F-Tag reader and signal adaptation to RS232.
- connection to LCD terminal and conversion of the RS232 signal in a 20 mA signal.
- connection to the IO-Bus.
- voltage supply for Peltier cooling element (+5V).

b) Front Panel Adapter Board

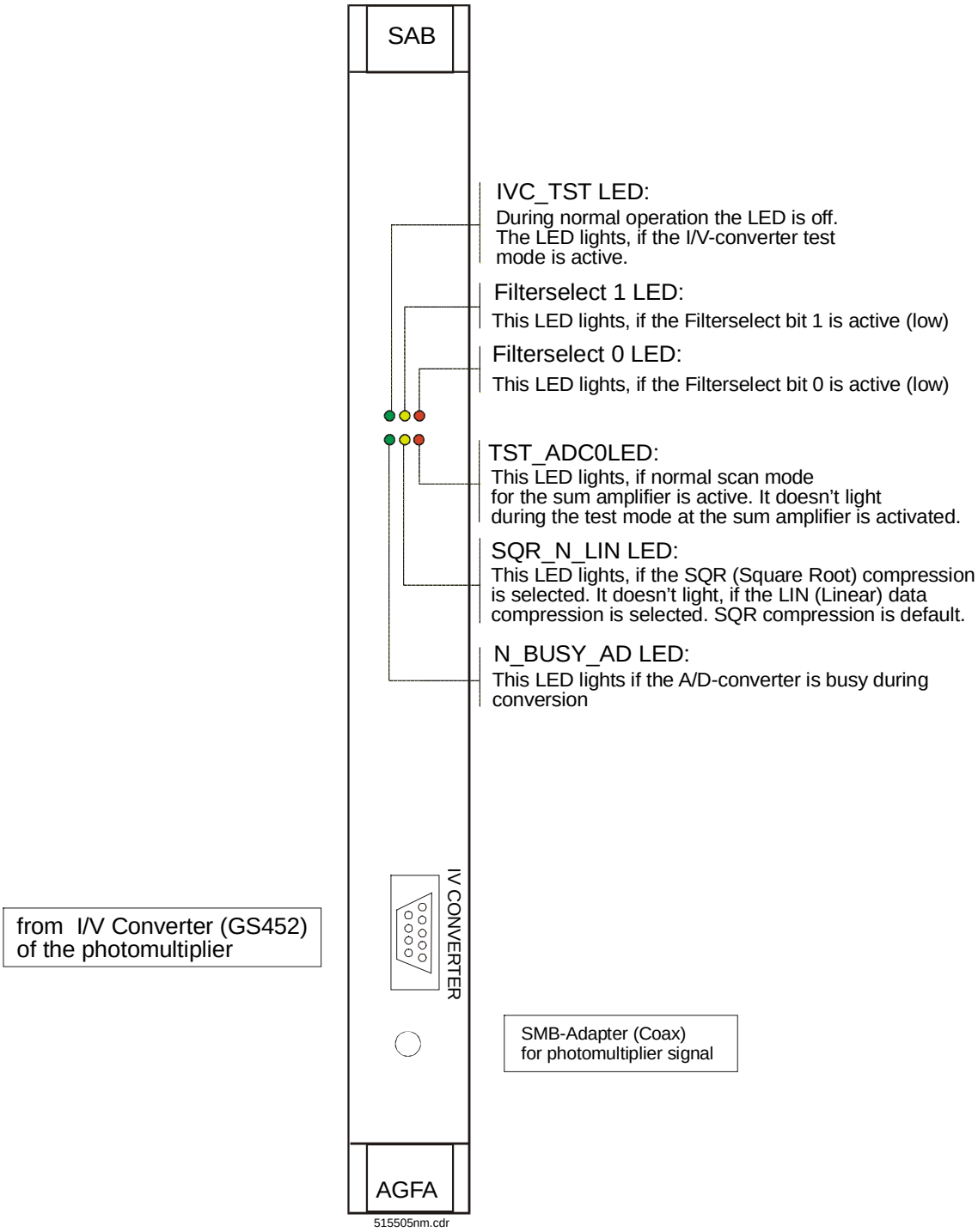


3.1.6.3 SAB Board (Scan Acquisition Board)

a) Main Functions

- conversion of analog voltage to digital signal.
- compression and filtering the signals from the photomultiplier.

b) Front Panel SAB Board

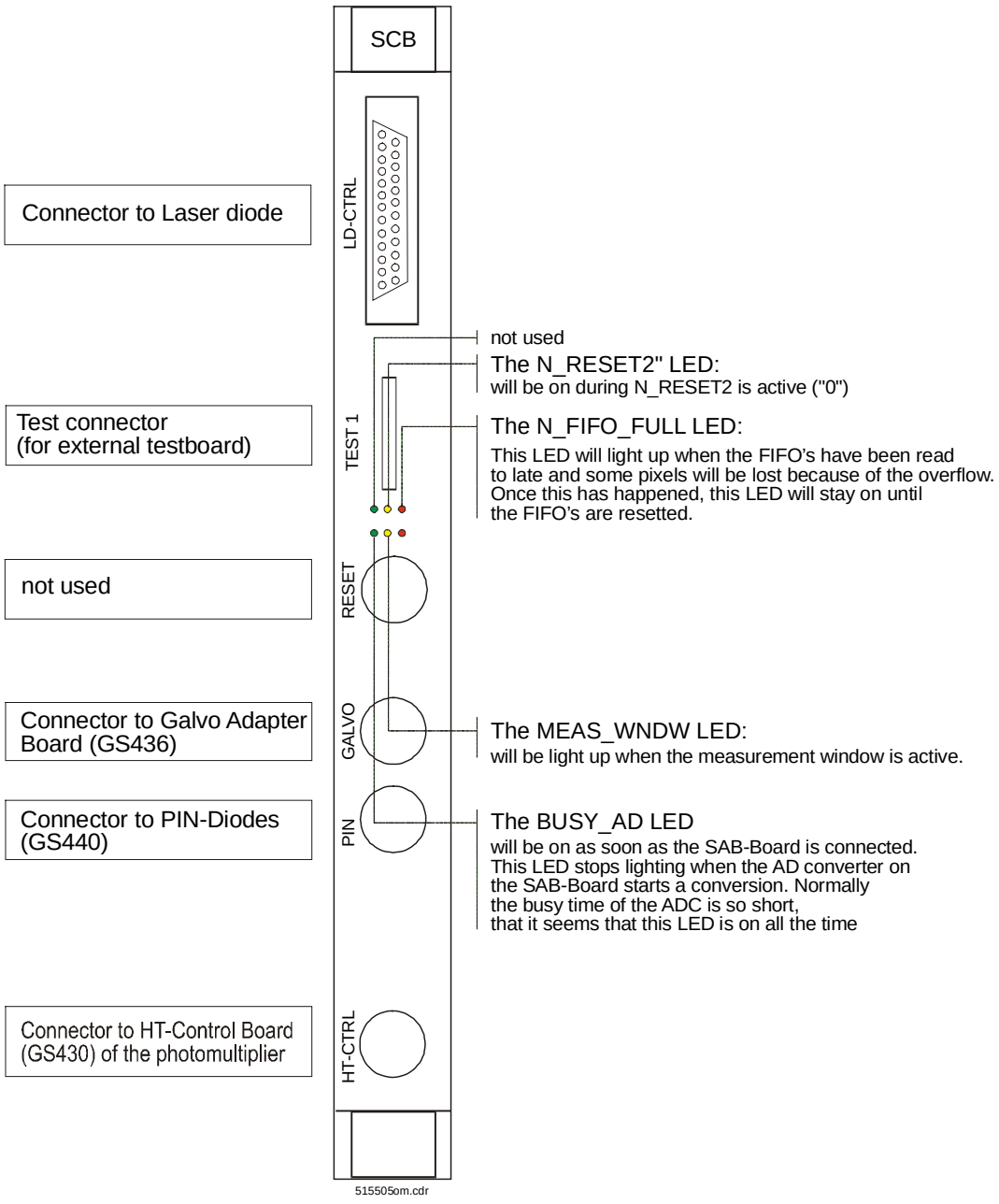

SAB
IVC_TST LED:
During normal operation the LED is off.
The LED lights, if the I/V-converter test mode is active.
Filterselect 1 LED:
This LED lights, if the Filterselect bit 1 is active (low)
Filterselect 0 LED:
This LED lights, if the Filterselect bit 0 is active (low)
TST_ADC0LED:
This LED lights, if normal scan mode for the sum amplifier is active. It doesn't light during the test mode at the sum amplifier is activated.
SQR_N_LIN LED:
This LED lights, if the SQR (Square Root) compression is selected. It doesn't light, if the LIN (Linear) data compression is selected. SQR compression is default.
N_BUSY_AD LED:
This LED lights if the A/D-converter is busy during conversion
IV CONVERTER
from I/V Converter (GS452) of the photomultiplier
SMB-Adapter (Coax) for photomultiplier signal
AGFA
515505nm.cdr

3.1.6.4 SCB-Board (Scan Control Board)

a) Main Functions

- sweep amplitude and offset adjustment for the galvo.
- voltage adjustment for HT of the photomultiplier.
- adaptation of scan speed.

b) Front Panel SCB Board


SCB
LD-CTRL
Connector to Laser diode
not used
The N_RESET2" LED:
will be on during N_RESET2 is active ("0")
TEST 1
Test connector
(for external testboard)
The N_FIFO_FULL LED:
This LED will light up when the FIFO's have been read
to late and some pixels will be lost because of the overflow.
Once this has happened, this LED will stay on until
the FIFO's are resetted.
RESET
not used
GALVO
Connector to Galvo Adapter
Board (GS436)
The MEAS_WNDW LED:
will be light up when the measurement window is active.
PIN
Connector to PIN-Diodes
(GS440)
The BUSY_AD LED
will be on as soon as the SAB-Board is connected.
This LED stops lighting when the AD converter on
the SAB-Board starts a conversion. Normally
the busy time of the ADC is so short,
that it seems that this LED is on all the time
HT-CTRL
Connector to HT-Control Board
(GS430) of the photomultiplier
515505om.cdr

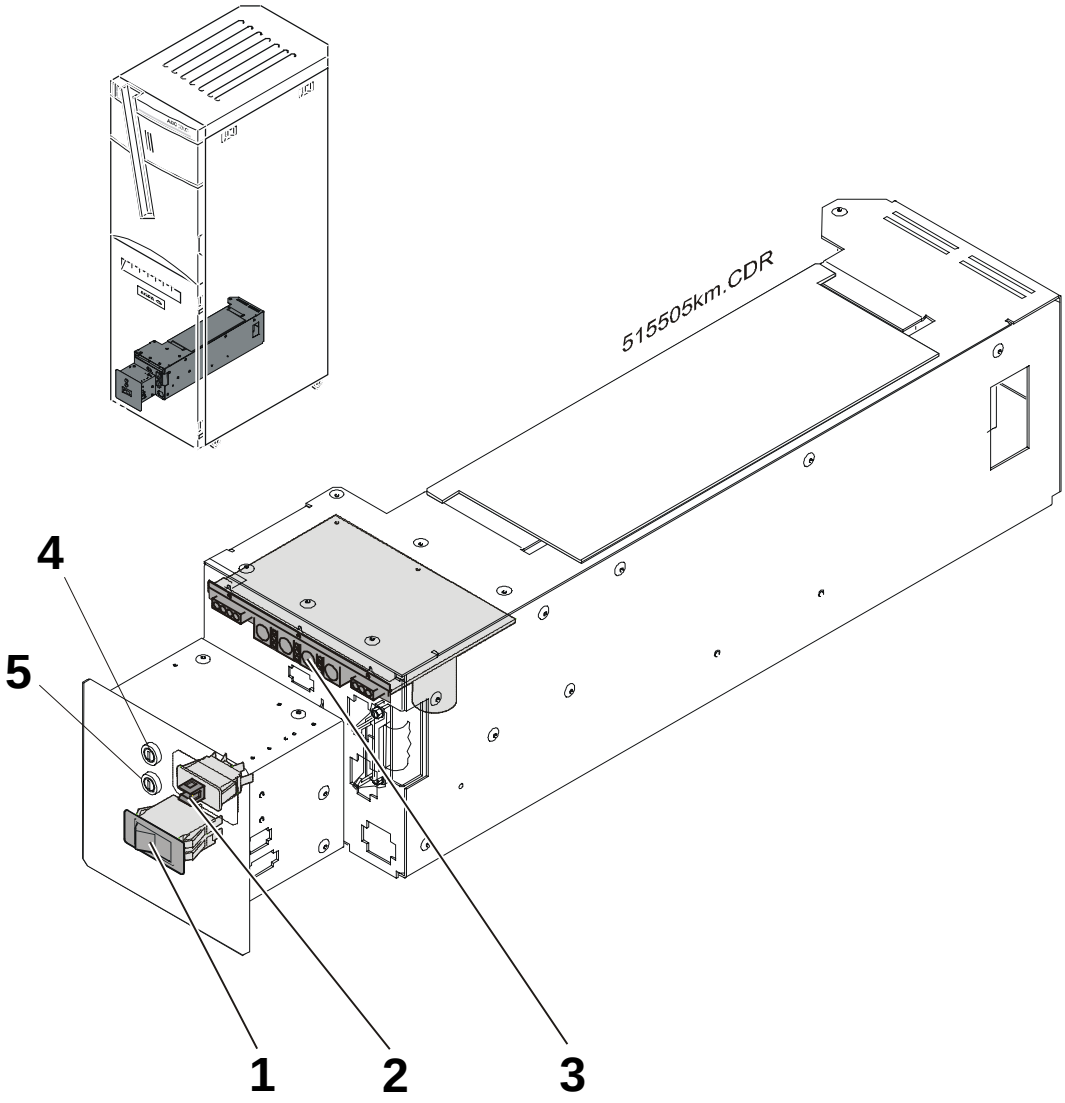
Note:
The external testboard is used for troubleshooting to display following signals on an oscilloscope

- digital PIN-diode signal
- A/D measurement window
- sweep signal.
- analog PIN-diode signal

3.1.7 Power Unit

a) **Main Functions**
Power supply for:
- erasure unit.
- VME-rack.
- step motors and SM boards.

b) Components

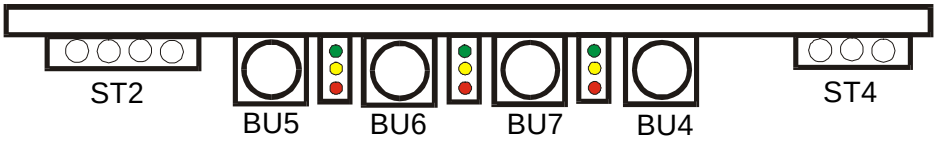


1	main switch
2	interlock switch
3	power integration board
4	fuse for galvo power supply (Si 201, 2A slowblow)
5	fuse for step motor transformer (Si 202, 2A slowblow)

3.1.7.1 Power Integration Board

a) Main Functions

- recognition and control of the required periphery
  - vacuum pump
  - magnetic valve
  - voltage supply for galvo (+15V) and laser diode
  - fan for erasure unit
  - fan for power unit
- the following units can be checked directly via hard- or software
  - magnetic valve
  - voltage supply for galvo (+15V)
  - interlock for SM-voltage
  - SM-voltage of the transformer
  - fan for erasure unit
  - vacuum pump (indirectly via current of the pump motor)
- optical LED's for error analysis



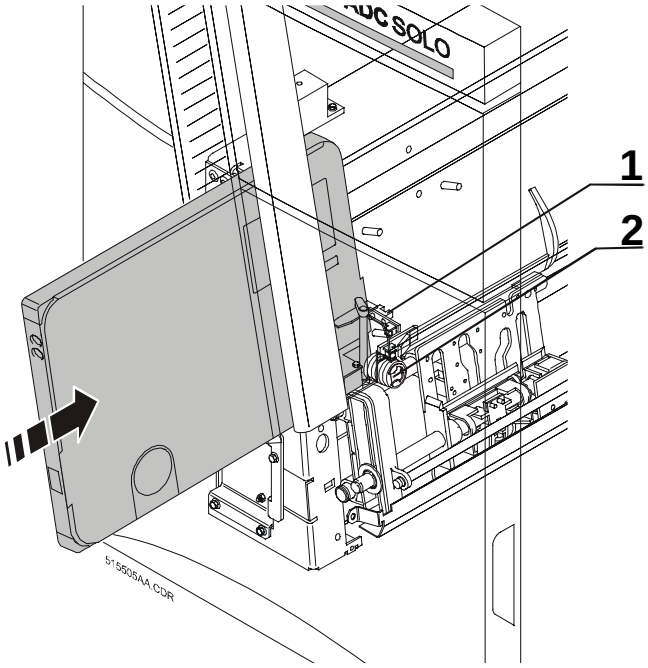
5155051m.cdr

ST2:	voltage supply for SM boards in cassette unit (+40V)
ST4:	voltage supply for galvo (+15V)
BU4	voltage supply for laser diode (+15V)
BU5	voltage supply for SM boards in scan unit (+40V)
BU6	voltage supply for HT-power supply (+24V)
BU7	voltage supply for power integration board (+24V)

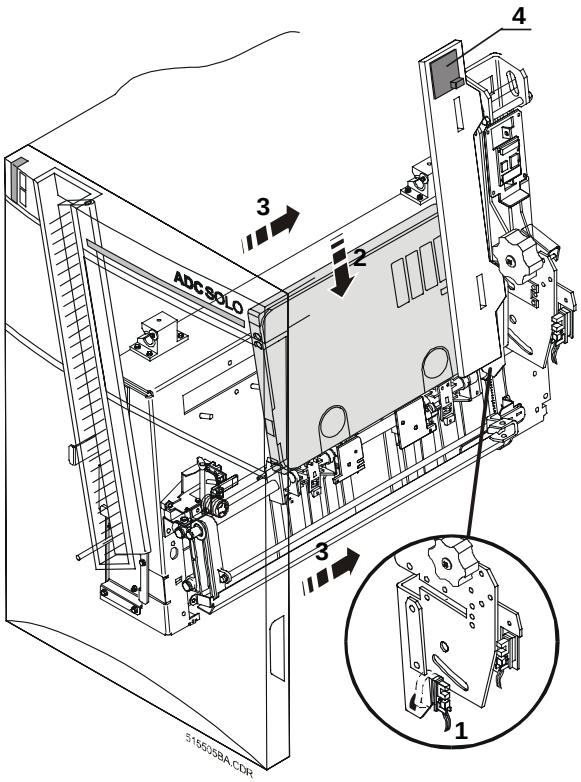
3.2 Machine Cycle

3.2.1 Cassette Input

- a light barrier (1) recognizes the insertion of a cassette .
- the roller (2) takes the inserted cassette and moves it to its first stop position.

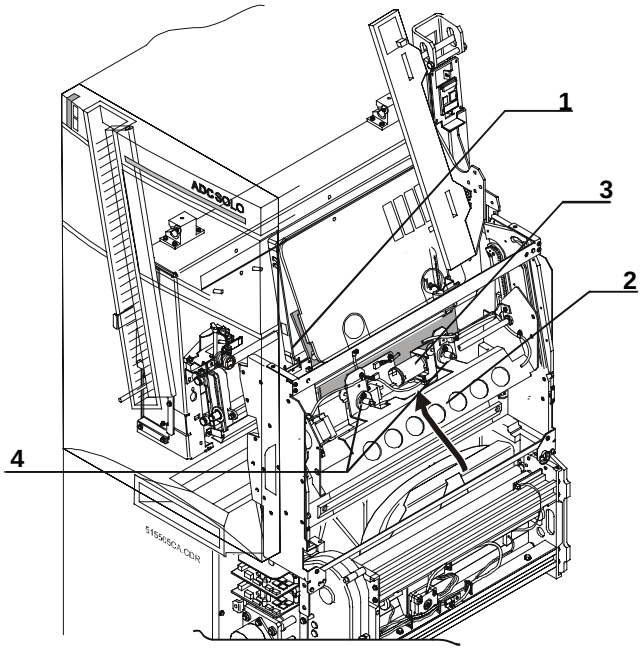


- a plastic bolt activated by the rear slider of the cassette interrupts a light barrier (1). This makes sure that only ADC Compact cassettes are accepted and the cassettes are inserted in the right way.
- cassette is lowered (2) and clamped.
- while the cassette unit moves to the right (3) the R/F-tag reader (4) recognizes the ID-Data of the cassette as well as its size.
  The cassette unit is roughly positioned corresponding to the size of the cassette.



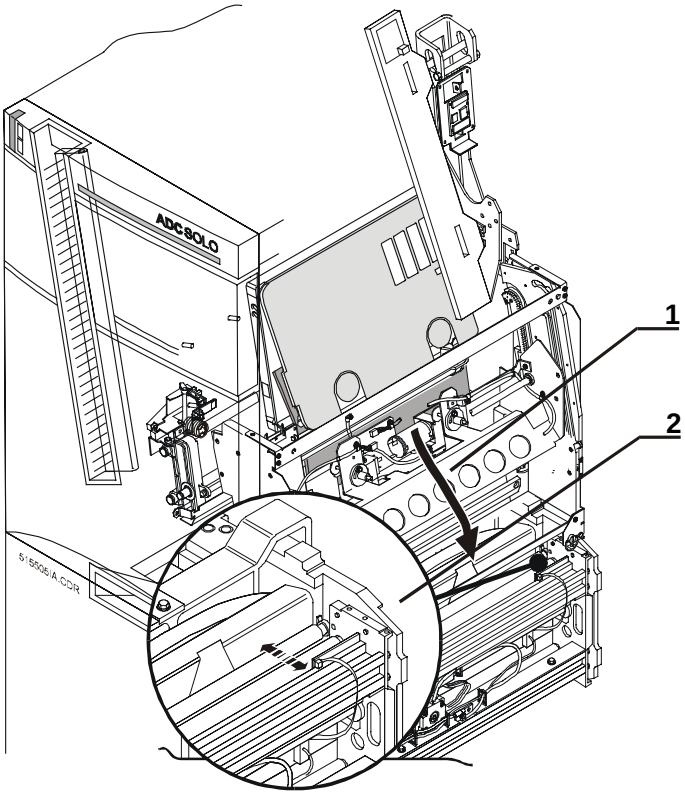
3.2.2 Opening the Cassette and Sucking the IP

- cassette is opened (1).
- the robot of the IP-transport unit moves up quickly (2).
- the vacuum pump starts (3).
- opening the valve.
- sucking the IP with the suction cups (4).



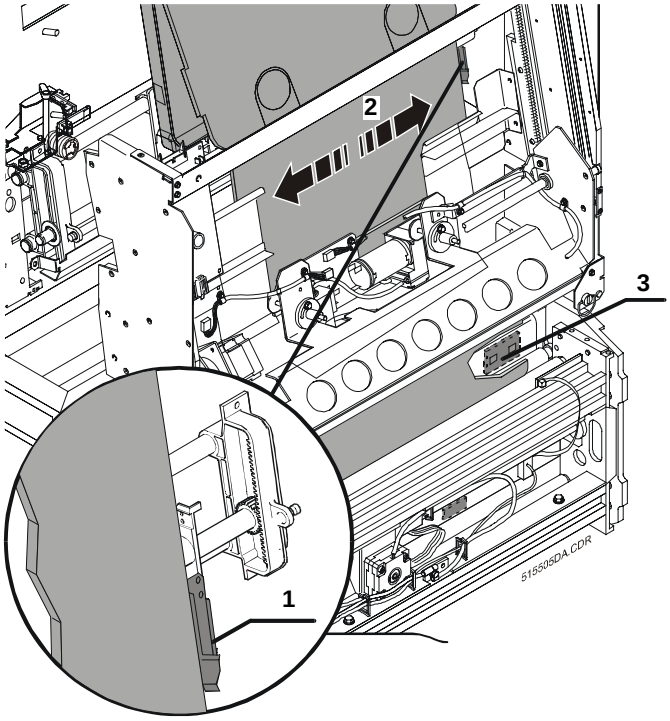
3.2.3 Taking the IP out of the Cassette and down to the Scan Unit

- the robot takes the IP out of the cassette and down to the scan unit (1).
- scan rollers start and move apart (2), while vacuum is reduced.

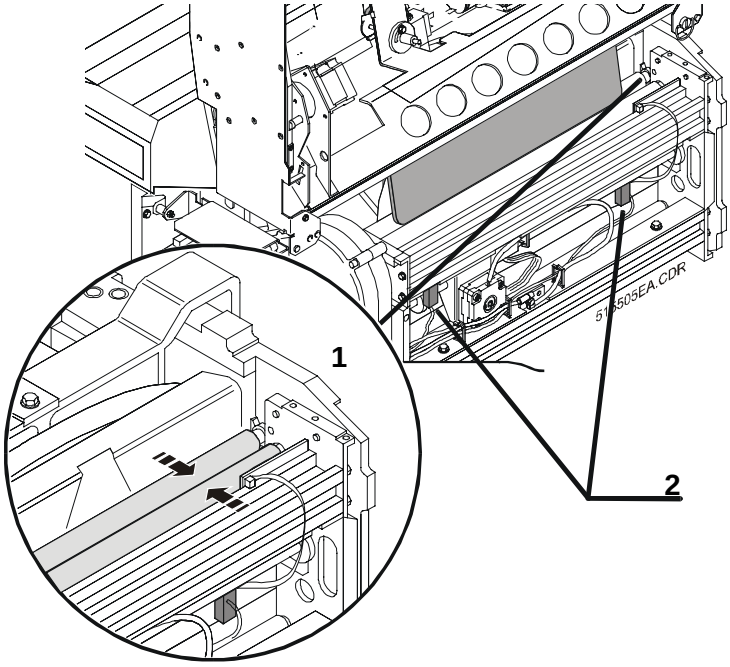


3.2.4 Format dependent Positioning of the IP relative to the Scan Unit

- the suction cups let the IP go off and ...
- ... the rollers stop.
- the IP-alignment (1) positions the IP (2) exactly at the scan unit with the aid of a long distance light barrier (3).
  The IP-Alignment moves with the IP until lightbarrier (3) is interrupted.
  Then the IP-Alignment moves back until the lightbarrier is not interrupted any longer.



- the scan rollers clamp the IP (1) and...
- ... take the IP down until its edge reaches the PIN-diodes (2).



3.2.5 Stimulate and Scan the IP (Optical Path)

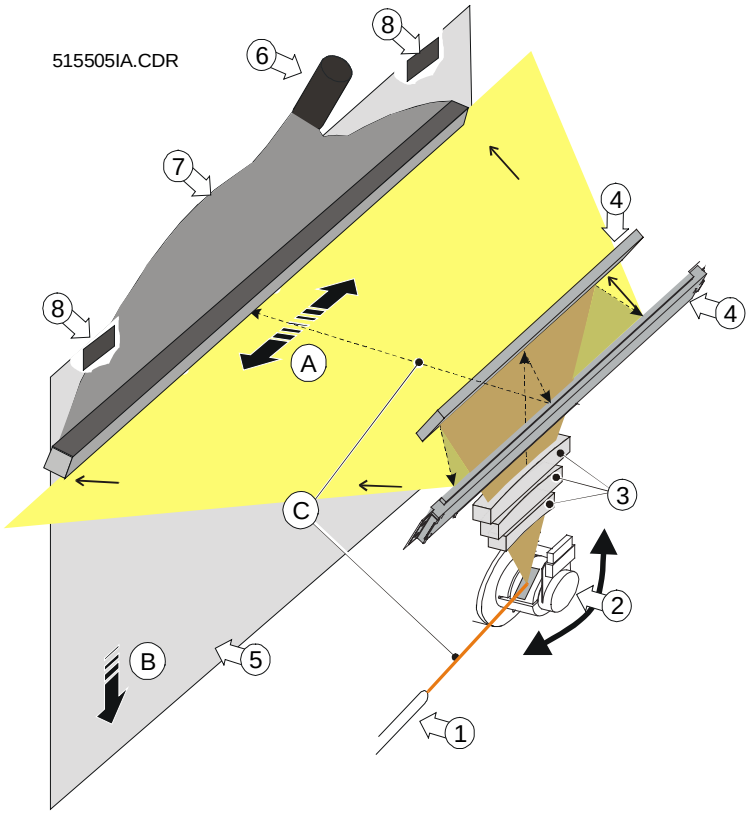
A fast scan direction
(sweeping laser beam)

B slow scan direction
(movement of the IP)

C laser beam

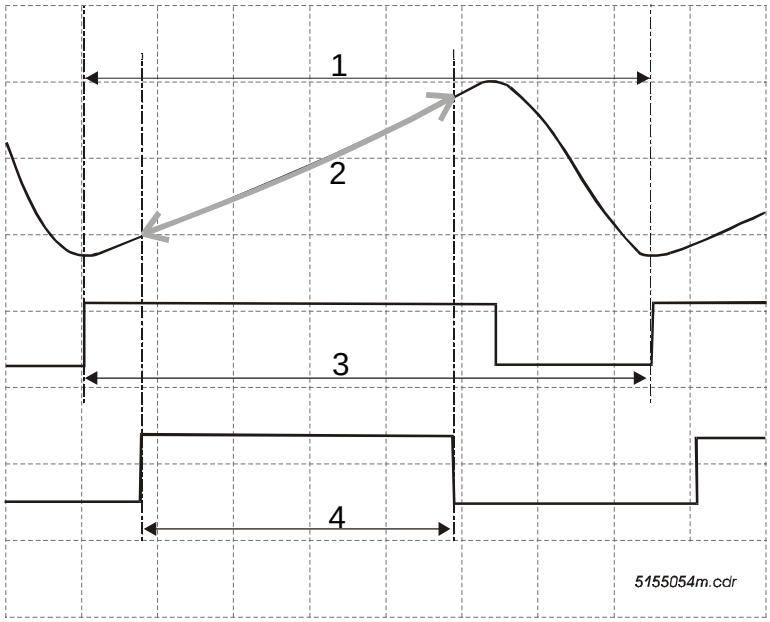
1 Laser diode
2 Galvo
3 F-theta lens
4 Mirror
5 Image Plate
6 Photomultiplier
7 Fibre optics
8 PIN diodes

Image Plate



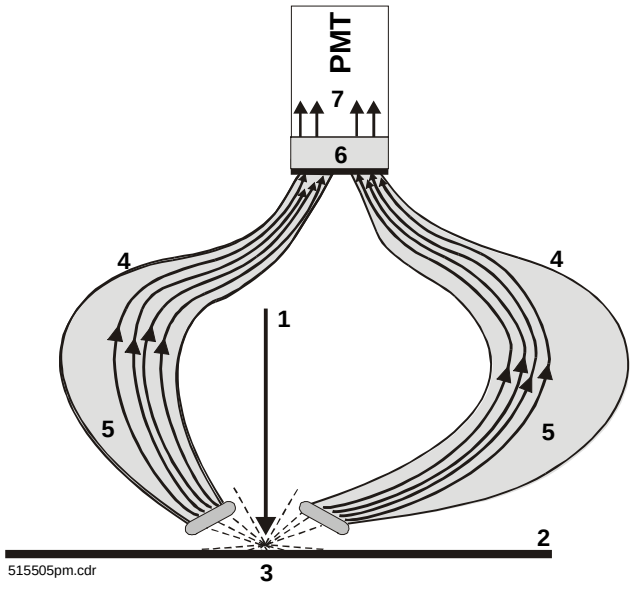
3.2.6 Stimulate and Scan the IP (Trigger Signals)

- sweep signal (1)
  control signal for the galvo;
  generated in the SCB board.
- period of constant laser speed (2).
- signal controlling the laser beam(3).
- signal 1 and 3 are synchronized in the SCB - board.
- A / D window (4)
  time period when the image is actually digitized.



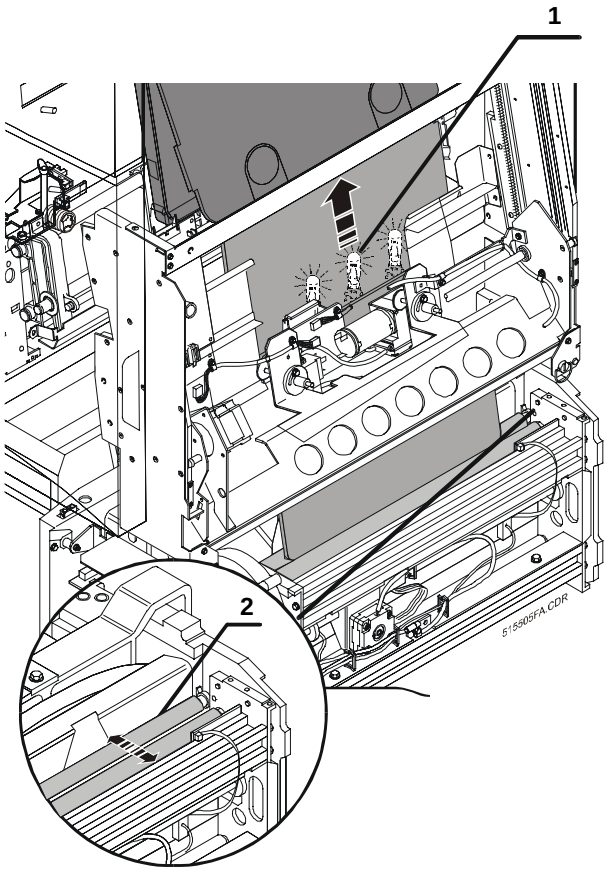
3.2.7 Collecting the Light

- laser beam (1) (red light) stimulates the IP (2).
- light is emitted to all directions (3).
- fibre optics (4), 2x 6500 fibres.
- light (5) guided through the fibre optics.
- filter (6) allows only blue light to pass.
- only blue light (7) is taken to the PMT and converted into current.



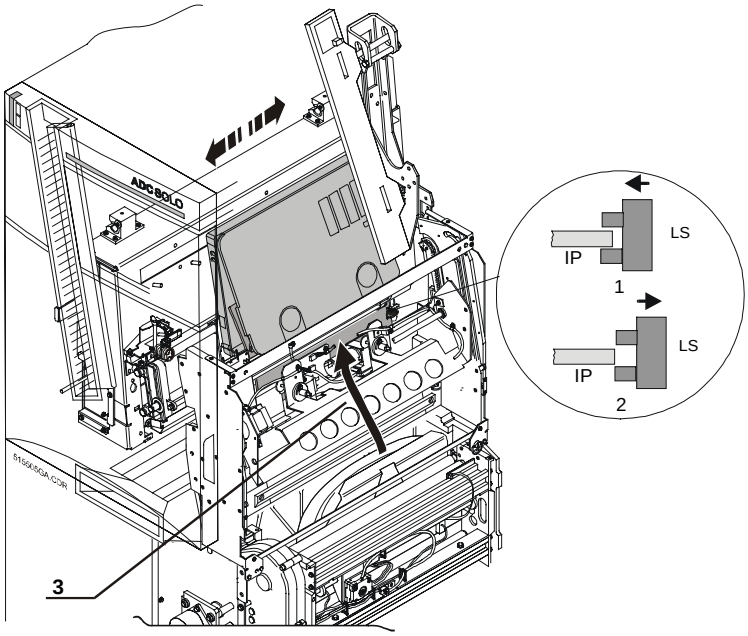
3.2.8 Unloading the IP from the Scan Unit / Image Erasion

- scan rollers stop after scan process.
- erasure lamps switch on (1).
- scan rollers move the IP up to the robot.
- vacuum pump is started and the IP is sucked.
- the scan rollers move apart (2).
- the robot moves the IP over the erasure unit up to the cassette.
- erasure lamps switch off.



3.2.9 Positioning the Cassette Unit relative to the IP

- before being reloaded, the cassette unit is positioned relative to the IP.
  The cassette unit moves to the IP until the lightbarrier is being interrupted(1).
  The unit moves back until the light barrier is not interrupted any longer (2).
- IP is reloaded to the cassette (3).
- the suction cups let the IP go off.
- the robot moves down quickly to home position while the cassette is closed.

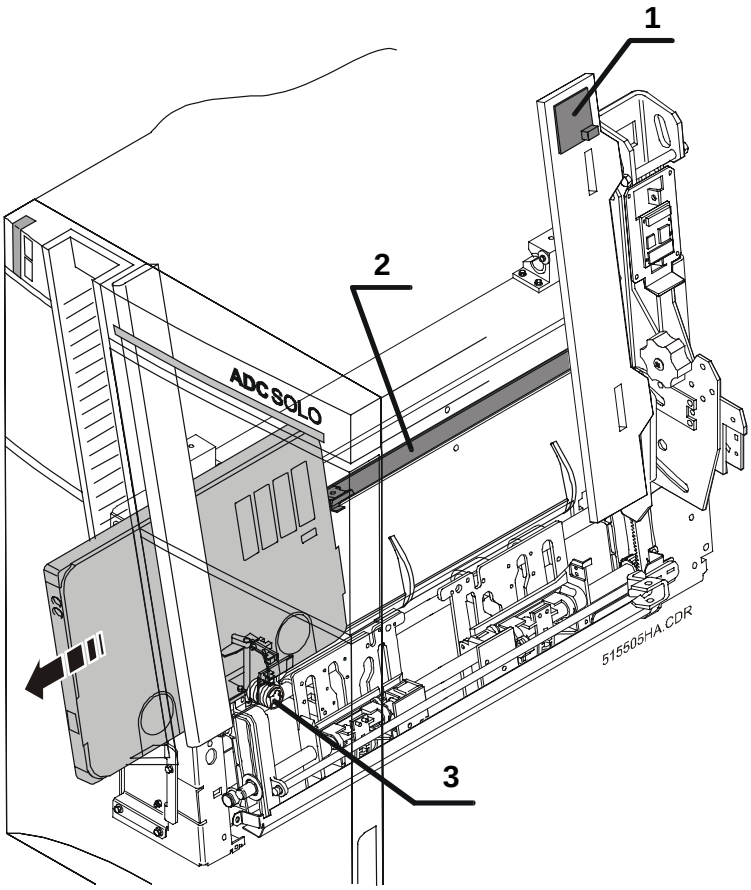


3.2.10 Cassette Output

- cassette unit moves to the left, while...
- ...the RF-Tag (1) changes status of cassette ID-chip to „erased“.
- the cassette is unclamped and lifted; the I/O-slot is unlocked.
- the toothed belt (2) and the roller (3) move the cassette through the I/O-slot.

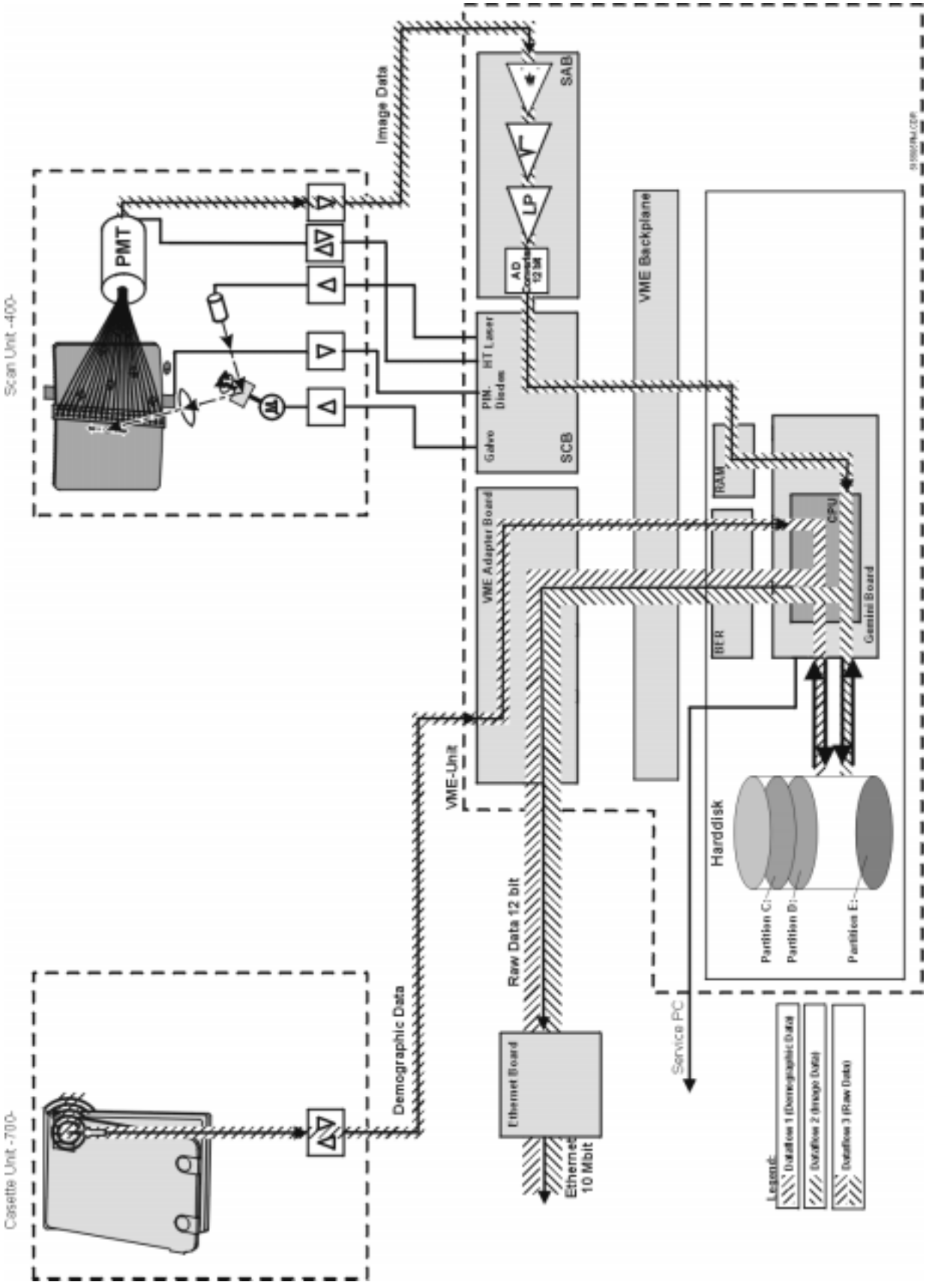
After removing the cassette from the digitizer

- cassette unit moves to home position

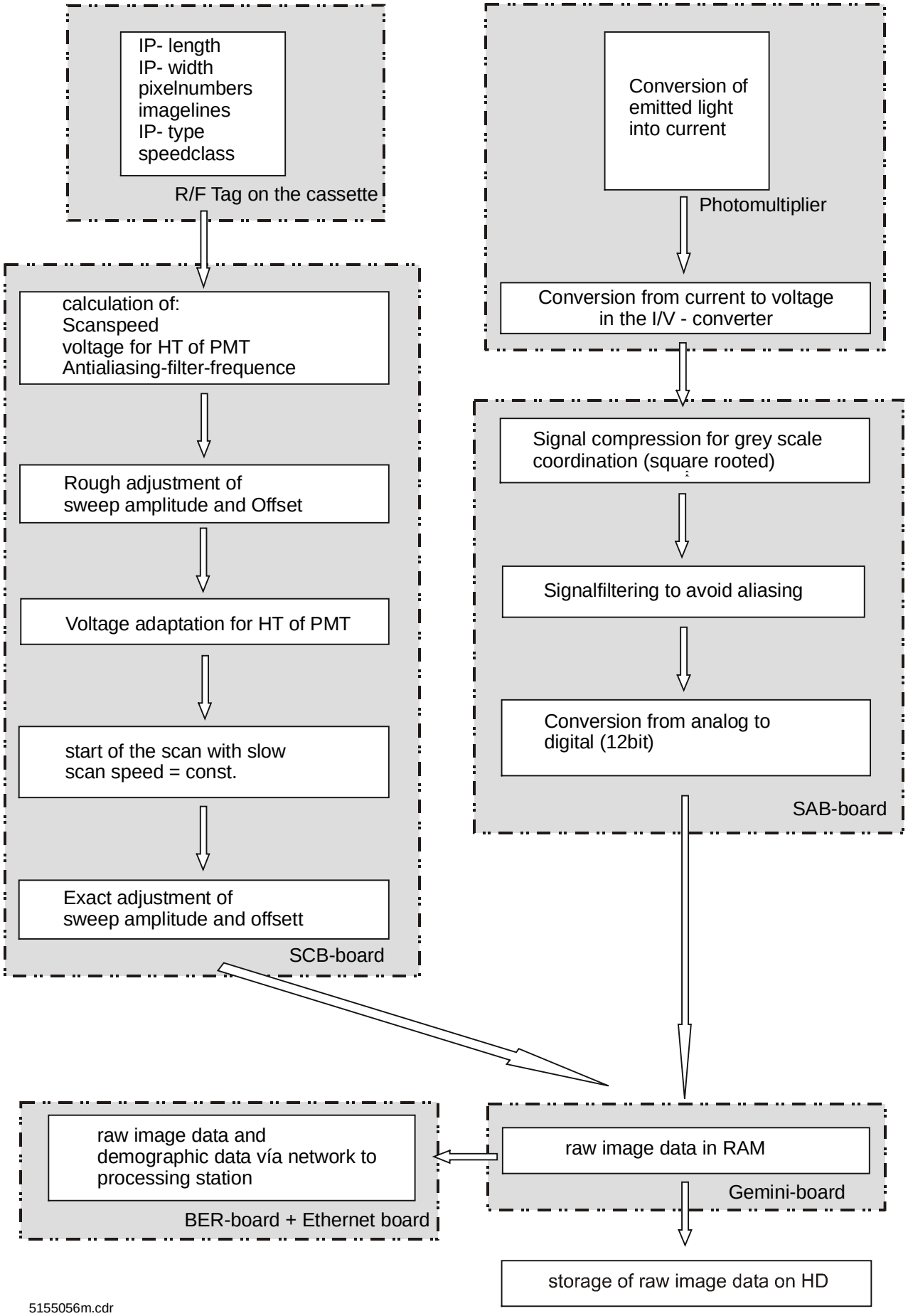


4 Signal- and Data Flow

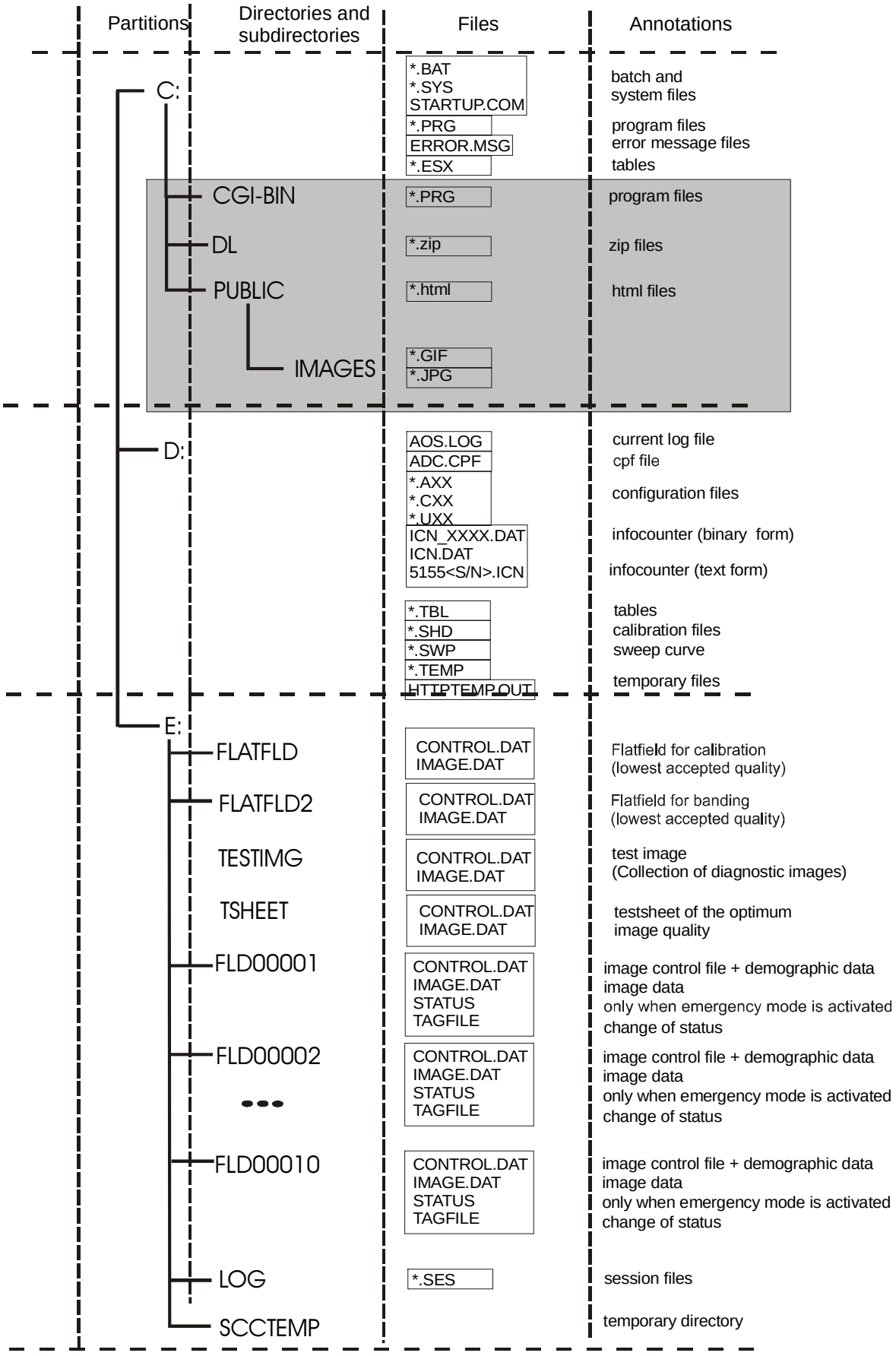
4.1 Signal Flow



4.2 Image and Control Data Flow


IP- length
IP- width
pixelnumbers
imagelines
IP- type
speedclass
R/F Tag on the cassette
Conversion of emitted light into current
Photomultiplier
Conversion from current to voltage in the I/V - converter
calculation of:
Scanspeed
voltage for HT of PMT
Antialiasing-filter-frequence
Rough adjustment of sweep amplitude and Offset
Voltage adaptation for HT of PMT
start of the scan with slow scan speed = const.
Exact adjustment of sweep amplitude and offsett
SCB-board
Signal compression for grey scale coordination (square rooted)
Signalfiltering to avoid aliasing
Conversion from analog to digital (12bit)
SAB-board
raw image data and demographic data vía network to processing station
BER-board + Ethernet board
raw image data in RAM
Gemini-board
storage of raw image data on HD
5155056m.cdr

4.3 Partition Map of the Harddisk



Annotations:

The grey rectangle marks the directories which are only necessary for remote control.

A CD-ROM containing the test images is now availiable: CM+9.5145.1055.0

The E – partition must not be formatted; otherwise all test images would be lost. To avoid any formatting, the 'format' program is delivered no longer.

The complete harddisk will be formatted and partitioned when the 'boot' floppy is used.

4.4 FLDXXXXX-directories:

CONTROL.DAT (Image control file)**:**

There are six possibilities of the status in an image control file:

queued *:	waiting for transmission
sending:	transmission in progress
sent:	transmission completed, waiting for response
transmitted:	positive response from workstation
warning*:	positive response, but file cannot be handled from workstation at the moment => new transmission
error*:	faulty file, transmission cancelled

Note:

Only images being in the status marked with a "*" can be deleted.

STATUS

A status file will only be created when the operator pushes the emergency button.

TAGFILE

File date and time when the status is changed.

4.5 NVE-List

The following table is just for information purposes – there is absolutely no part in it which is user configurable. One part of the data is set by configuring the device with the CPF file, the other part is maintained internally.
Unlike the MG3000 (where there is no hardware), any modification to these NVFs can cause severe damages to the hardware!

Task	Instances	Description
ARTXXX00	0..23	Apip Routine Table – stores hostname, IP address and port of known destinations
SYSXXX00	0..0	SYStem Starter – defines all the components to be started
RTTXXX00	0..0	Remote Target Table – holds information about subnetmask and defaultrouter
ETSXXX00	0..0	EThernet Server – definition of network servers to be started
NETXXX00	0..0	TCP/IP Stack – definition of table sizes
ICNXXX00	0..0	Info CouNters – location of files
CGIXXX00	0..0	CGI communication server – starts HTTP server
COCXXX00	0..0	COmpact Control – same as for ADC Compact, keeps track of the device status
UIFXXX00	0..0	User InterFace – communication properties
DSKXXX00	0..0	DiSK – auxiliary functions to handle the floppy – defines patterns to datafiles to be saved as backup
CPFXXX00	0..0	CPF parser – the location of the CPF is stored here
IOCXXX00	0..0	IObus Controller – Configuration data related to IOBUS components
CASXXX00	0..1	CASsette Data Translator – Definition of the demographic data used with the EMERGENCY buttons
DCMXXX00	0..0	DiCoM driver – DICOM configuration
BACXXX00	0..0	Buffer ACquisition – all configuration data related to the internal spooler
MIFXXX00	0..0	MIFare Tagreader – tagreader configuration
SCNXXX00	0..0	SCaNner – Scanner parameters
FIPXXX00	0..19	Format IP – table to store IP parameters
SSCXXX00	0..0	SlowSCan – parameters of the slowscan driver
SCCXXX00	0..0	SCanner Calibration – parameters related to the scanner calibration
HDCXXX00	0..0	HanDling Control – current status of the handling
CAMXXX00	0..0	CAssette Module – positions, timeouts, ...
TRAXXX00	0..0	TRAnsport Unit – positions, timeouts, ...
ALNXXX00	0..0	ALigNment Unit – positions, timeouts, ...
GODXXX00	0..0	GOoDies Starter – specification of helper components to be started
DRAXXX00	0..0	DRAwing Unit – converts curves into images, image properties
REDXXX00	0..0	REDirector – keeps track of destination status and transmission properties (enabled/disabled, rerouting)
QUEXXX00	0..0	QUEue Viewer – Spooler Queue Viewer, no configurable data
TIGXXX00	0..0	Test ImaGe Launcher – initiates the sending of the testimages